

(12) UK Patent Application (19) GB (11) 2 261 502 (13) A

(43) Date of A publication 19.05.1993

(21) Application No 9121111.0

(22) Date of filing 04.10.1991

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(51) INT CL⁶

G01N 21/47

(52) UK CL (Edition L)

G1A AA10 AG15 AG7 AMM AP16 AP2 AS4 AT1
AT14 AT20

(56) Documents cited

EP 0119618 A2 EP 0046389 A2 US 4632563 A
US 4355897 A US 3924252 A US 3885162 A
US 3792272 A

(58) Field of search

UK CL (Edition K) G1A ADJ ADM AMM
INT CL⁶ G01N

(54) Smoke detection device

(57) A light metering device for detecting the amount of smoke in smoke-laden gas in which a source (15) emits a light beam into one end of a cylindrical chamber, which contains a sample of the gas. The light beam travels along the chamber and is modulated by a light interrupter (20) before being reflected, at an acute angle back through the chamber on to a detector (16) located adjacent to the source (15), by a reflector (17) located at the other end of the chamber. The detector includes a demodulator arranged so that only the light which has travelled the full length of the chamber will be detected. The device may include: reflectors arranged to cause the light beam to traverse the chamber a plurality of times before being directed on to the detector (16), clean air shielding to prevent contamination of the optics and subdividing of the chamber to reduce the amount of stray signals.

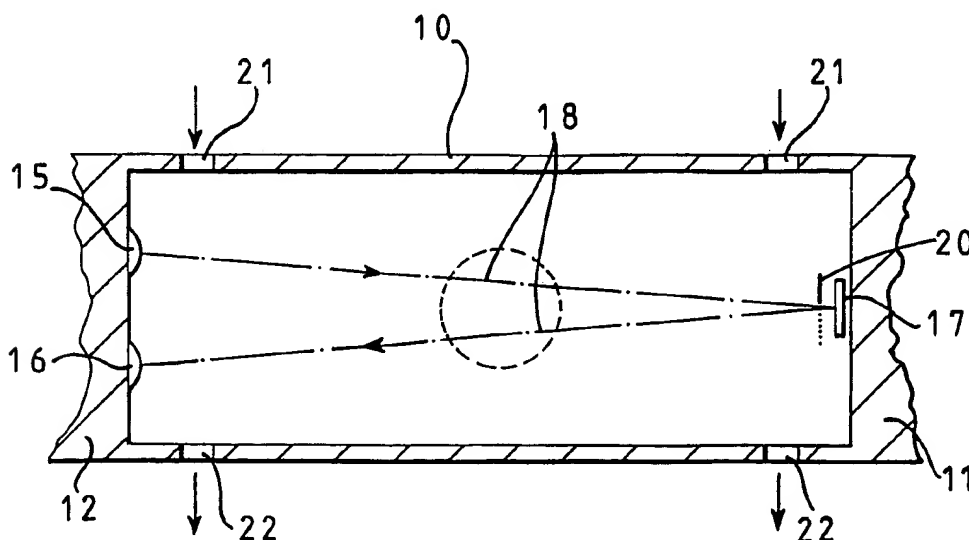


FIG 1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

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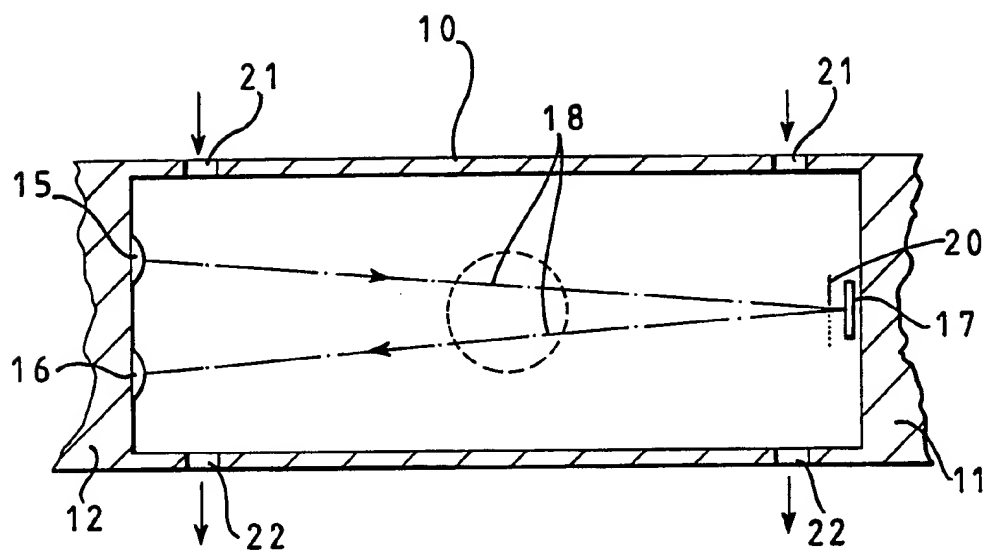


FIG 1

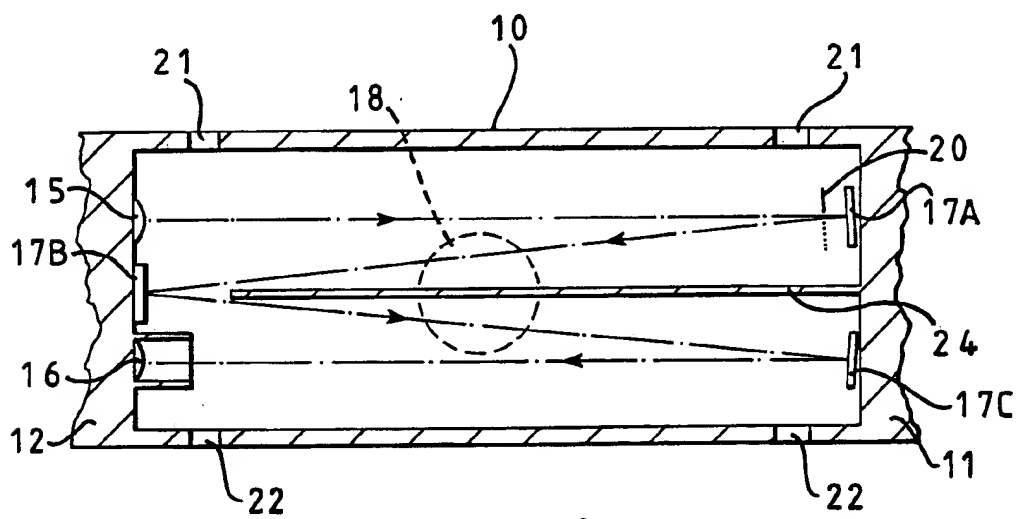


FIG 2

LIGHT METERING DEVICE

This invention relates to light metering devices and in particular such devices as may be used in metering the amount of smoke in a smoke laden gas.

In measuring the amount of smoke in a smoke laden gas it has been proposed to meter the smoke content by passing a beam of light through the gas and detecting the amount of light reaching a light detector to give an indication of the quantity of smoke particles in the gas. For the greatest accuracy a relatively large sample of the smoke laden gas should be used. Hitherto this has been achieved by passing the gas into a relatively long tube having at one end a light emitting device and at the other end a light detecting device and the longer the tube the more accurate the metering tends to be. However, in practice the longer the tube the more cumbersome and impractical the metering unit becomes.

An object of the invention is to provide a device whose overall size is kept to a minimum.

According to the invention a light metering device comprises light emitting means and light detecting means, the light emitting means directing a beam of light to reflecting means capable of reflecting the light beam towards the light detecting means, the beam from the light emitting means and the beam from the reflecting means being disposed at an acute angle to one another, the device further comprising interrupting means for interrupting the passage of light between the light emitting means and the light detecting means and control means whereby only the light which has reached the light detecting means after being reflected off the reflecting means is recorded by the light detecting means.

The light interrupting means can take various forms such as a rotating disc interposed between the light emitting means and

the light detecting means, the disc during its rotation permitting the transmission of the beam during only part of each rotation. Other interrupting means can be utilised such as polarising lenses which are intermittently polarised to permit reflection on an intermittent basis, tilting reflecting means, such as mirrors, prisms and the like which are intermittently positioned to reflect the beam towards the light detecting means.

The control means is normally arranged to enable the light detecting means to detect the beam of light only when the reflecting means is directing the beam of light towards the light detecting means. Thus any light reaching the light detecting means other than from the reflecting means, for example by dispersion from the smoke particles, will not be treated as having been passed through the smoke sample. The frequency of interruption of the light beam between the light emitting means and the light detecting means would be known and the light detecting means only accepts signals which have been reflected from the reflecting means and which, therefore, have travelled the full length of the beam.

In this arrangement the light emitting means and the light detecting means can lie side by side and the length of the tube through which the smoke laden gas is passed may be reduced by a factor of two, three or more compared with an arrangement in which the light emitting means and the light detecting means are at opposite ends of the tube. More than one light reflecting means may be employed so that the beam is reflected several times before it reaches the light detecting means, further increasing the length of the beam without increasing the length of the apparatus.

Further features of the invention will appear from the following description of embodiments of the invention given by way of example only and with reference to the drawings, in which:-

Figure 1 shows schematically one version of light metering means, and

Figure 2 shows another version of light metering means.

Referring to the drawings and firstly to Figure 1 there is shown part of a smoke metering system consisting of a tube 10 closed at its ends 11 and 12 and having an inlet for smoke laden gas as, for example, at 13.

At the end 12 of the tube 10 is located to one side of the tube a light emitting device 15 and to the other side of the tube a light detecting device 16. At the opposite end 11 of the tube 10 is centrally located a reflector 17.

A beam of light 18 is directed from the light emitting device 15 for reflection from the reflector 17 towards the light detecting device 16. Thus, the light beam 18 passes over a distance of approximately twice the length of the tube 10 between its ends 11 and 12. When the tube 10 is filled with smoke laden gas the amount of light reaching the detecting means 16 is reduced according to the quantity of smoke within the gas sample. However, if the arrangement simply consisted of a simple mirror reflecting means and light detecting means which picked up all the light directed at it the arrangement would not give a true representation of the amount of smoke in the sample because the detecting means 16 would pick up light dispersed towards the detecting means by the smoke and other contents of the gas sample such as water vapour. The arrangement overcomes this problem by providing means to interrupt the reflection of the beam 18 between the light emitting device and the detecting means at a predetermined frequency, such as by a rotating chopper disc 20.

By this arrangement the disc 20 rotates in front of the reflecting device 17 and has a segment of the disc removed to allow the passage of light over a pr determined portion of

each rotation of the disc. Over the remainder of each rotation reflection of the light towards the detecting means 16 is prevented. Control means is associated with the detecting means 16 whereby the light signals detected are only those light signals which have resulted from reflection by the reflecting means 17. By this means it is only the amount of light which has passed from the light emitting means 15 to the reflecting means 17 and back to the detecting means 16 which is registered by the detecting means. Such quantity of light has, therefore, passed the full length of the beam 18. The control means ensures that the detecting means only accepts signals which have been reflected and signals from the control means are directly proportional to the amount of smoke in the smoke sample.

As an alternative to the chopper disc other ways of interrupting the beam at a predetermined frequency can be provided, such as incorporating in the reflecting means polarising means operated at a predetermined frequency to ensure reflection in accordance with such frequency. Other alternatives include mirrors or prisms oscillating at a predetermined frequency.

The arrangement of Figure 1 also includes means for inhibiting the deposit of materials from the smoke laden gas onto the light emitting means 15 and the light detecting means 16 at one end of the tube 10 and on the reflecting means 17 at the other end of the tube 10. As shown openings are provided at the opposite end of the tube 10 to admit clean air through an inlet opening 21 and an outlet opening 22 for the smoke in each case. The flow of air between the openings 21 and 22 ensures that the smoke does not reach the vicinity of the respective surfaces.

Referring now to Figure 2, this shows a similar arrangement to that of Figure 1 and the same reference numbers are used for similar parts in each embodiment. In the Figure 2 arrangement

the light emitting means 15 and the light detecting means 16 are located side by side towards one end of the tube 10 but the light beam 18 is reflected three times by reflecting means 17A, 17B and 17C. The tube 10 is, in this case, provided with a splitter 24 which serves to prevent light at one side thereof from passing to the other side except through the reflecting means 17B.

A chopper disc 20 is also provided in the Fig. 2 arrangement together with control means (not shown) associated with the light detection means 16, as previously described. The disc 20 may be replaced by other light interrupting means as described in relation to Fig. 1.

Claims

1. A light metering device which comprises light emitting means and light detecting means, the light emitting means directing a beam of light to reflecting means capable of reflecting the light beam towards the light detecting means, the beam from the light emitting means and the beam from the reflecting means being disposed at an acute angle to one another, the device further comprising light interrupting means for intermittently interrupting the passage of light between the light emitting means and the light detecting means, and control means whereby the light reaching the light detecting means after reflection off the reflecting means is recorded by the light detecting means.
2. A device according to claim 1 comprising a housing through which the beam of light is directed through which housing smoke laden gas is passed whereby the device monitors the amount of smoke in the gas.
3. A device according to any one of the preceding claims wherein the light interrupting means comprises a rotatable disc interposed between the light emitting means and the light detecting means, the disc being arranged to permit the transmission of the beam of light during only part of each rotation.
4. A device according to claim 1 or 2 wherein the light interrupting means comprises polarising means, the polarising means being intermittently polarised to permit passage of the beam of light on an intermittent basis.
5. A device according to any one of the preceding claims wherein the control means and the light interrupting means are arranged so that the light receiving means registers the receipt of light from the emitting means when the light interrupting means is not interrupting the

beam of light.

6. A device according to any one of the preceding claims comprising reflecting means capable of effecting two or more reflections of the beam of light in its passage between the light emitting and light detecting means.
7. A device according to claim 2 wherein the housing is in the form of tube along which the beam of light is passed, the tube having means for admitting and exhausting a flow of smoke laden gas.
8. A device according to claim 7 wherein the tube has the light emitting means and the light detection means located towards one end thereof, light reflection means being located towards the opposite end of the tube.
9. A device according to any one of the preceding claims comprising dividing means dividing the beam of light to the reflecting means from the beam of light to the detecting means.
10. A light metering device substantially as described with reference to Fig. 1 or Fig. 2 of the drawings.

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Patents Act 1977

**Examiner's report to the Comptroller under
Section 17 (The Search Report)**

Application number

9121111.0

Relevant Technical fields

(i) UK Cl (Edition K) G1A (AMM, ADM, ADJ)

(ii) Int Cl (Edition 5) G01N

Search Examiner

J A WATT

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

21 JULY 1992

Documents considered relevant following a search in respect of claims

1-10

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	EP A2 0119618 (ERWIN SICK) - Figure 1 line 23 page 8 to line 4 page 9	Claims 1,3,6
X,Y	EP A2 0046389 (ANDROS) - Figures 1 and 2 line 36 page 4 to line 37 page 5	X: 1,2,3, 7 Y: 8
X,Y	US A 4632563 (LORD, III) - Figures 1 and 2 Columns 4 to 6 and Figure 12 lines 30 to 36 Column 12	X: 1,2,3, 7 Y: 8
X	US A 4355897 (KAYE) - Figures 1 and 4 lines 44 to 67 Column 4	1,3,5
X	US A 3924252 (DUSTON) - Figures 1 and 2 line 59 Column 1 to line 10 Column 2 lines 31 to 38 Column 2	1,5
X	US A 3885162 (GEERTZ) - whole document	Claim 1 at least
X	US A 3792272 (HARTE ET AL) - Figure 3 line 54 Column 7 to line 12 Column 8	Claim 1 at least

Category	Identity of document and relevant passages	Relevant to claim(s).

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

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